free-wheeling diode may be electrically connected in parallel to the clamping diode **560**.

[0058] According to other embodiments the electric assembly **500** is part of a half-bridge circuit. In half-bridge circuits, a high-side switch and a low-side switch are electrically connected in series with regard to their load paths. A load is connected to an intermediate network node connecting the high-side switch and the low-side switch. A gate driver circuit alternatively turns on and off the high-side switch and the low-side switch.

[0059] If the switching devices of the half-bridge circuit are IGFETs, typically a body diode of the high-side switch allows a current to flow that dissipates energy stored in the inductances at the switched load side after the low-side switch has turned off. A body diode of the low-side switch allows a current to flow that dissipates energy stored in the inductances at the switched load side after the high-side switch has turned off.

[0060] If the switching devices of half-bridge circuit are IGBTs, after the lowside switch has turned off, a freewheeling diode electrically connected in parallel to the high-side switch allows a current to flow that dissipates energy stored in the inductances at the switched load side. After the high-side switch has turned off a freewheeling diode electrically connected in parallel to the low-side switch allows a current to flow that dissipates energy stored in the inductances at the switched load side.

[0061] In both cases, the body diodes and the free-wheeling diodes operate in the forward mode. Since the body diodes and the free-wheeling diodes are typically not avalanche-rugged, the blocking capability of the body diodes and the free-wheeling diodes is typically the same or higher as the blocking capability of the semiconductor switch they are assigned to. By contrast, the clamping diode **560** according to the embodiments responds to a reverse overvoltage condition. The clamping diode **560** protects the switching device **510** from being subjected to any voltage beyond the maximum breakdown voltage rating. Since the clamping diode **560** can sustain at least 80% of a maximum long-term load current rating of the switching device **510** for at least 500 ns, 1 μs or 5 μs, the clamping diode **560** is safe from being destructed by repetitive overvoltage conditions occurring in switching cycles with a repetition rate of at most 50 kHz.

[0062] Compared to conventional approaches that avoid destructive overvoltage conditions by selecting switching devices with a maximum voltage blocking rating far beyond the highest supply voltage, i.e., by considering a high safety margin as regards the breakdown voltage at the cost of power efficiency, the clamping diode **560** allows the use of switching devices **510** with lower electric losses.

[0063] For example, for an application that supplies voltages of at most 600 V, a conventional half-bridge circuit typically may include switching devices with a maximum breakdown voltage rating of 1200 V, wherein 1200 V devices typically have significantly higher losses than 600 V devices. Due to the high overvoltage ruggedness of the electric assembly **500**, a 900 V switching device with inherently lower losses may replace the 1200 V switching device without loss of reliability.

[0064] Due to the breakdown-rugged clamping diode **560** the electric assembly **500** is less sensitive to parasitic inductances. A wiring between components of the electric assembly **500** as well as a wiring of an electric module including the electric assembly **500** may get along without expensive low-inductance wiring connections. Design requirements for the wiring on/to component carriers such as, e.g., a PCB (printed circuit board) are more relaxed.

[0065] In FIG. **1**C a reference voltage curve **411** as well as a reference current curve **412** illustrate the switching behavior of the switching device **510** of FIG. **1**A without the clamping diode **560**. After starting the turn-off, the voltage V_{L1L2} between the first and the second load terminals L**1**, L**2** steeply rises at t=t**0**. After some time, at $V_{L1L2}=V_S$ (V_{DC}) the load current I_L begins to steeply fall. Energy stored in the magnetic fields of parasitic inductances at the switched load side or between the voltage source supplying the supply voltage V_S and the load terminal at the supply side induces a dissipation current increasing the potential at the supply side and/or lowering the potential at the switched load side of the switching device **510** to below the lower potential of the supply voltage V_S. A significant overvoltage condition may occurIn half-bridge configurations, turn-on overvoltage of a free-wheeling diode of the complementary switching circuit may superimpose to the potential at the switched side. The voltage V_{L1L2} may exceed the maximum breakdown voltage rate V_{BR} of the switching device **510** of FIG. **1**A.

[0066] A voltage curve **401** as well as a current curve **402** illustrate the switching behavior of the electric assembly **500** of FIG. **1**A with the clamping diode **560**. After start of turn-off at t=t, the voltage V_{L1L2} steeply rises. When at t=t**1** the voltage across the electric assembly **500** exceeds the avalanche voltage V_{AV} of the clamping diode **560**, the latter starts to conduct. The voltage across the switching device **510** does not exceed the avalanche voltage V_{AV}, which is higher than the supply voltage V_S and lower than the maximum breakdown voltage rating V_{BR} of the switching device **510**.

[0067] The clamping diode **560** is an avalanche diode designed to safely handle the avalanche phenomenon without getting destroyed. In an avalanche diode the avalanche breakdown takes place in a central region, whereas in other diodes the avalanche breakdown typically takes places in a termination region between the central region and an outer lateral surface of a semiconductor body. Avalanche diodes typically specify a maximum repetitive areal Avalanche energy E_{AR}/A of at least 0.5 J/cm^2 or at least 2 J/cm^2 for pulses of 2 μs or at least 10 J/cm^2 for pulses of 20 μs at a duty cycle of the pulses of 0.1%. By contrast, in Schottky diodes, the maximum electric field strength is close to the metal-semiconductor interface and such that Schottky diodes are typically no suitable Avalanche diodes.

[0068] FIG. **1**D shows the safe operating area of the clamping diode **560** of FIG. **1**A for occasional avalanche events according to an embodiment. For example, for a SiC clamping diode with a die size of 5 mm^2, the clamping diode **560** can be in the avalanche breakdown for 20 μs without being irreversibly damaged, subject to that the avalanche current i does not exceed **25**A.

[0069] FIG. **2** refers to an electronic assembly according to an embodiment including a 1200V SiC-MPS diode as clamping diode with an avalanche voltage V_{Av}1200 V electrically connected in parallel to a 1700V Si-IGBT with a maximum breakdown voltage rating $V_{BR=}$1700V as switching device.

[0070] At t=t**0**, V_G voltage curve **423** for the gate voltage VG falls from above a threshold level to below the threshold level and turns off the 1700V Si-IGBT. A V_{CE} voltage curve